

Submission in Response to NSF CI 2030 Request for Information

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Research Domain, discipline, and sub-discipline

Hydrology, Hydraulics, Water Resources Management and Irrigation & Drainage

Title of Submission

Integrating Sensors for Improving Predictive Capability of Computational Models

Abstract (maximum ~200 words).

The submission emphasizes the development of secure, predictive tools to forecast weather parameters for longer time horizons in regional, continental and global scales for which essentially require high-performance computing systems, sensors for data collection and high speed networks with cyber security features to sustain homeland security. Currently the advances in sensor development have not been integrated for models in hydrologic and meteorological work. There is also a need for integrated modeling of multiple variables, rather than a limited set in hydrologic modeling. This is seen as a priority. It is also proposed that the different NSF Geoscience related directorates consider encouraging both sponsored (monetary support) and un-sponsored (no monetary support) modes of research. Enabling integrated model development in the mode of "open-source movement" not compromising security features will be useful.

Question 1 Research Challenge(s) (maximum ~1200 words): Describe current or emerging science or engineering research challenge(s), providing context in terms of recent research activities and standing questions in the field.

There have been considerable advances in modeling of geo-physical and geochemical modeling on one hand and sensor development on the other. The major challenge posed by climate change is the hard to predict variability in weather parameters such as temperature and rain/ snow fall. Predictive tools to forecast weather parameters for longer time horizons are to be developed in regional, continental and global scales for which essentially require high-performance computing with cyber security features to sustain homeland security. A cybernetic system between ground and air based sensors for updating parameters for the numerical modeling using high performance computing (HPC) for an integrated and scalable hydrologic model covering all phases of the water cycle has to be developed. The disparate modeling processes for the different weather and climate variables will have to be integrated towards generating a holistic and dynamic prediction, integrating the models with sensor data. This challenge is particularly pressing with regard to prediction of extreme events of flooding, snow fall, droughts etc.

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Question 2 Cyberinfrastructure Needed to Address the Research Challenge(s) (maximum ~1200 words): Describe any limitations or absence of existing cyberinfrastructure, and/or specific technical advancements in cyberinfrastructure (e.g. advanced computing, data infrastructure, software infrastructure, applications, networking, cybersecurity), that must be addressed to accomplish the identified research challenge(s).

A modern cyber infrastructure will have to be robust enough to be scalable both in space and time, interactive with air/ground based data through sensors and secure to result in accurate prediction through modeling. The infrastructure should take advantage of cloud computing and incorporate HPC systems, ultra high speed networks and assure secure dynamic data collection through networks of sensors. Since the development of a well integrated system requires a number of different scientists working together to develop an integrated model, secure flow of data, algorithms and discussions have to be enabled with assured levels of high security.

Question 3 Other considerations (maximum ~1200 words, optional): Any other relevant aspects, such as organization, process, learning and workforce development, access, and sustainability, that need to be addressed; or any other issues that NSF should consider.

It would be great if NSF could involve different scientists both in sponsored and unsponsored modes. Scientists may not be interested only in sponsored research and would like to get involved in projects outside the frame work of sponsored research. NSF should develop a system to incorporate and recognize research which may not necessarily sponsored with monetary support. A robust infrastructure to enable freer and more economical modes of research communications between researchers will be very useful. A new wave of advancement in communication technology for researchers to share and run different computational models is required to deal with climate change issues. NSF could also consider open-source code development initiatives for integrated modeling using HPC.

Consent Statement

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